

COURSE NUMBER: FHWA-NHI-135010**COURSE TITLE:** River Engineering for Highway Encroachments

The course provides training in the theory and application of alluvial channel flow, fluvial geomorphology, sediment transport, and river mechanics to the planning, location, design, construction, maintenance, and operation of highways. Material for this course comes from "Hydraulic Design Series 6 (HDS-6): River Engineering for Highway Encroachments - Highways in the River Environment." The course includes detailed coverage on how to estimate rates of sediment transport by selecting appropriate equations for use in the computations. Additional topics include sediment properties and sediment measurement techniques. Case histories provide practical examples of problems that occur at highway crossings and encroachments of streams and rivers. A computer generated 360-degree virtual tour site visit is used for a comprehensive workshop. Example problems in sediment transport will be worked by the course participants.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Apply open channel flow equations and concepts to flow in alluvial channels
- Determine resistance to flow and sediment transport at highway crossings
- Apply sediment transport and sediment continuity relationships for the analysis of streambed degradation and aggradation
- Evaluate the inter-relationships between fluvial (river) geomorphology and highway hydraulic design

TARGET AUDIENCE:

Engineers who are responsible for the evaluation of stream stability and the design of highway hydraulic structures. The course is designed for graduate engineers (BS) who have been trained in basic hydraulics of rigid-boundary, open channel flow.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

Technical Information: Larry Arneson • (720) 963-3200 • larry.arneson@fhwa.dot.gov

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COURSE NUMBER: FHWA-NHI-135027 (3-Day)
FHWA-NHI-135027A (4-Day)
COURSE TITLE: Urban Drainage Design

This course provides a detailed introduction to urban roadway drainage design. Design guidance for solving basic problems encountered in urban roadway drainage design is provided. The topics are hydrology including rational equation, soil conservation method, regression equations, and synthetic hydrographs; and highway drainage including gutter flow, roadway inlet interception, storm drain systems, energy and hydraulic grade lines, detention ponds, and stormwater management.

The 4-day course includes the basic 3-day course, plus presentation of the 1-day course FHWA-NHI-135028 Stormwater Pump Station Design.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Determine runoff (peak flows and volumes) from urban watersheds
- Apply basic hydraulic principles to urban drainage design
- Perform roadway drainage designs using various roadway inlets
- Size and/or analyze storm drain conveyance systems
- Establish the energy and hydraulic grade lines for storm drains
- Design and/or analyze detention basins
- Perform hydraulic design of pumping stations (with optional day four)

TARGET AUDIENCE:

Highway designers with limited experience in drainage design, but familiar with mathematical concepts such as algebra and geometry and have some working background in hydrology and hydraulics.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

FEE: \$530 Per Participant

LENGTH: 4.0 Days (CEU: 2.4 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

Technical Information: Dan Ghere • (708) 283-3557 • dan.ghere@fhwa.dot.gov



There are multiple delivery options for this course. Check our Web site for information on each delivery option.

COURSE NUMBER: FHWA-NHI-135028

COURSE TITLE: Stormwater Pump Station Design

This course provides an overview of the location and type selection of stormwater pump stations. A major portion of the course is devoted to recommended hydraulic design procedures for sizing and optimizing stormwater pump stations. This course is also offered as a 1-day add-on to FHWA-NHI-135027 Urban Drainage Design. Topics to be discussed include, site considerations, hydrology, storage, pump configuration, mass curve routing, pump selection, sump dimensions, and mechanical and electrical considerations.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Determine locations where pump stations are appropriate
- List types of pumps and pump stations
- Apply basic hydraulic principles to accomplish graphical mass curve routing
- Size pumps and determine start/stop elevations
- Determine storage volume needed
- Size wet wells according to industry standards

TARGET AUDIENCE:

Highway designers with some experience in storm drainage design, familiarity with mathematical concepts such as algebra and geometry, and a working background in hydraulics and hydrology.

FEE: \$200 Per Participant

LENGTH: 1.0 Days (CEU: 0.6 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

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COURSE NUMBER: FHWA-NHI-135041 (3-Day)
FHWA-NHI-135041A (3.5-Day)
COURSE TITLE: HEC-RAS, River Analysis System

The host is responsible for providing 15 computers with the following minimum configuration: 850 MHz Intel Pentium III Processor or equivalent with 128 MB RAM, Windows NT 4.0 with Service Pack 6a or 98 Second Edition or 95 (SR-1), 100 MB available disk space, CD-ROM drive, and 1024 x 768 color video display.

HEC-RAS is a computer program designed as the successor to the U.S. Army Corps of Engineers' Hydraulic Engineering Circular HEC-2, Water Surface Profiles program (WSPRO). The program incorporates the Standard Step Method for Water Surface Profile computations, bridge hydraulics, including the method presented in WSPRO, culvert hydraulics, flood encroachments, design of open channel flow, analyzing split flow options and sub- and supercritical flow computations. The program can be used to compute bridge pier and abutment scour following the HEC-18 guidelines. The program is Windows-based and uses a graphical user interface for file management, data entry and editing, program execution and output display. It provides easy conversion from English to metric units and vice versa.

Both courses provide an overview and hands-on experience with the computer program, including modeling of bridges, but the 3.5-day version adds coverage of culvert modeling or multiple-opening bridges. A representative from the host agency is encouraged to contact the instructor when setting up the course to determine which length course would best suit the needs of the course participants and if the 3.5-day version is requested whether coverage of culverts or multiple-opening bridges is preferred. Each participant will receive a notebook containing the course notes, and a CD containing user documentation, HEC-RAS software, and example computer workshops.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Apply the conservation of mass, energy and momentum to computations of water surface profiles, hydraulics of bridges, and the hydraulics of culverts
- Create cross section, bridge, and culvert data files
- Create flow files
- Run the HEC-RAS computer program to solve all applications as presented in this course
- Troubleshoot the output data to determine the validity of the results

TARGET AUDIENCE:

Federal, State, and local hydraulic engineers who have responsibility for the design and analysis of river systems and stream crossings. Participants should have experience in using the Windows environment and knowledge of the fundamentals of open channel flow, including basic understanding of HEC-2 or WSPRO.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

FEE: \$460 Per Participant

LENGTH: 3.5 Days (CEU: 2.1 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

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There are multiple delivery options for this course. Check our Web site for information on each delivery option.

COURSE NUMBER: FHWA-NHI-135046**COURSE TITLE:** Stream Stability and Scour at Highway Bridges

This course provides comprehensive training in the prevention of hydraulic-related failures of highway bridges. The effects of stream instability, scour, erosion, and stream aggradation and degradation are covered. Material for the 3-day course comes primarily from two Hydraulic Engineering Circulars (HEC), "Evaluating Scour at Bridges" (HEC-18), and "Stream Stability at Highway Structures" (HEC-20).

The course provides training in conducting a stream stability classification and qualitative analysis of stream response. Quantitative techniques are provided for estimating long-term degradation, and calculating the magnitude of general and local scour at bridge piers and abutments for simple and complex substructures. A comprehensive workshop integrates qualitative analysis and analytical techniques to determine the need for a plan of action for correcting stream instability and scour problems.

FHWA-NHI-135048 Countermeasure Design for Bridge Scour and Stream Instability is a recommended subsequent course that provides training in the selection and design of countermeasures for stream instability and scour problems, including development of a plan of action and an introduction to fixed and portable instrumentation for scour monitoring.

See the listing for FHWA-NHI-135047 Stream Stability and Scour at Highway Bridges for Bridge Inspectors for a description of the 1-day course for bridge inspectors.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Identify stream instability and scour problems at bridges
- Define problems caused by stream instability and scour
- Estimate the magnitude of scour at bridge piers and abutments and in the bridge reach

TARGET AUDIENCE:

Federal, State, and local highway hydraulic, structural, and geotechnical engineers and bridge inspectors responsible for maintaining the integrity of highway bridges against possible hydraulic related problems. Consultants who do bridge engineering work are encouraged to attend.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

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COURSE NUMBER: FHWA-NHI-135047

COURSE TITLE: Stream Stability and Scour at Highway Bridges for Bridge Inspectors

This course is an abbreviated presentation of FHWA-NHI-135046 Stream Stability and Scour at Highway Bridges. The course provides an understanding of and assistance in detecting hydraulic-related problems at highway bridges. The effects of stream instability, scour, erosion, and stream aggradation and degradation are covered. Countermeasures to these problems are discussed. This course concentrates on visual keys to detecting scour and stream instability problems and provides an introduction to portable scour monitoring instrumentation. The course emphasizes inspection guidelines to complete the hydraulic and scour-related coding requirements of the National Bridge Inspection Standards (NBIS). This course can be offered as a 1-day module in conjunction with the 3-day FHWA-NHI-135046 or as a stand-alone presentation.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Identify stream instability and scour problems at bridges
- Conduct field evaluations for scour and stream instability problems and properly code the results in the National Bridge Inventory
- Recognize countermeasures for stream instability and scour

TARGET AUDIENCE:

Federal, State, and local highway bridge inspectors responsible for detecting possible hydraulic-related problems that may threaten the integrity of highway bridges. Consultants who do bridge inspection work for the States may attend if space is available.

FEE: \$200 Per Participant

LENGTH: 1.0 Days (CEU: 0.6 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

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See page 6 in the front of the catalog for course registration information and page 9 for a coordination checklist.

COURSE NUMBER: FHWA-NHI-135048 (2.5-Day)
FHWA-NHI-135048A (3-Day)

COURSE TITLE: Countermeasure Design for Bridge Scour and Stream Instability

This course provides an overview of countermeasures to highway related failures from the effects of stream instability, scour, erosion, and stream aggradation and degradation problems. Material for the 2.5-day course comes primarily from Hydraulic Engineering Circular (HEC) "Bridge Scour and Stream Instability Countermeasures - Experience, Selection, and Design Guidance" (HEC-23).

Given a stream instability and scour problem, participants will select appropriate countermeasures to correct the problem. The course provides training in recommended strategies for developing a plan that includes appropriate countermeasures, including alternatives to conventional riprap and filter design.

Participants will apply hydraulics analysis techniques to countermeasure design for seven design guideline workshops. The course provides an introduction to fixed and portable instrumentation for scour monitoring using slides and video demonstrations. Participants will receive training in designing a monitoring program to reduce the risk from scour.

NHI Course 135046 provides training in identifying and analyzing stream instability and scour problems at highway bridges and is recommended as a prerequisite for this course.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Develop a plan of action for a scour critical bridge
- Propose countermeasures for stream instability and scour problems
- Identify countermeasures for bridge scour and stream instability using the HEC-23 countermeasures matrix
- Design selected countermeasures with HEC-23 design guidelines

TARGET AUDIENCE:

Federal, State, and local highway hydraulic, structural, and geotechnical engineers and bridge inspectors responsible for maintaining the integrity of highway bridges against possible hydraulic-related problems. Consultants who do bridge engineering work are also encouraged to attend.

FEE: \$335 Per Participant

LENGTH: 2.5 Days (CEU: 1.5 Units)

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

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There are multiple delivery options for this course. Check our Web site for information on each delivery option.

COURSE NUMBER: FHWA-NHI-135056

COURSE TITLE: Culvert Design

This course provides participants with the recommended design procedures for the hydraulic design of culverts. Material for the 3-day course comes primarily from "Hydraulic Design of Highway Culverts," Hydraulic Design Series No. 5 (HDS-5), which is provided to participants. "Hydraulic Design of Energy Dissipators for Culverts and Channels" (HEC-14) is discussed, but not provided. Culvert Hydraulic Design/Analysis Computer Program (HY-8) is discussed and demonstrated. However, this is not a "hands-on" computer course. A portable hydraulic flume is set up in the classroom for the participants to observe hydraulic principles and the hydraulic effects of culverts, improved inlets, pipe slope, material roughness, and various end treatments. The participants measure velocity, discharge, and headwater in the flume under various conditions and use the information to make actual design calculations.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Identify design alternatives based on culvert type, material, shape, and service-life considerations
- Describe the factors that govern inlet and outlet control and describe how each factor influences culvert performance
- Calculate tailwater depth and velocity and describe how tailwater affects culvert performance
- Design conventional culverts using HDS-5
- Improve culvert performance for inlet control culverts by designing an improved inlet using HDS-5
- Evaluate culvert outlet velocity and the need for energy dissipators, and select alternative energy dissipators using HEC-14
- Identify appropriate computer programs for culvert and energy dissipator design

TARGET AUDIENCE:

The course is suitable for entry-level personnel who have some drainage design experience or have taken FHWA-NHI-135065A and is valuable as a refresher course for those with previous culvert design training or experience.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

Technical Information: Joe Krolak • (202) 366-4611 • joseph.krolak@fhwa.dot.gov

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COURSE NUMBER: FHWA-NHI-135065

COURSE TITLE: Introduction to Highway Hydraulics

This course is based on Hydraulic Design Series No. 4 (HDS-4), "Introduction to Highway Hydraulics." The objective of the course is to provide a broad overview of basic highway drainage concepts. Fundamental hydraulic concepts are discussed, followed by open-channel flow principles and design applications of open-channel flow in highway drainage, including the design of stable channels, and pavement drainage. Closed-conduit concepts and applications in highway drainage include the application of culvert and storm drainage design. The presentation concludes with an introduction to concepts and design of energy dissipators. Detailed design criteria are drawn from other Hydraulic Design Series manuals and Hydraulic Engineering Circulars (HECs), providing a broad overview of all components of highway drainage design with an emphasis on practical applications. A portable hydraulic flume is set up in the classroom for the participants to observe numerous hydraulic principles. The participants take velocity and discharge measurements from the flume while in various setups and use the information to make design calculations.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Calculate design discharge using the rational method or regression equation procedures
- Apply the continuity and energy equation to solve practical design problems
- Use the Weir equation to calculate the flow overtopping a roadway embankment
- Use Manning's equation to calculate velocity or flow depth in simple or compound channels and recognize when this equation cannot be appropriately applied
- Evaluate channel flow conditions (subcritical, critical, or supercritical) using the Froude number
- Design a stable channel using basic hydraulic concepts and Hydraulic Engineering Circular HEC-15
- Apply basic pavement drainage concepts in calculation procedures described in HEC-22
- Design a simple culvert crossing using the procedures in HDS-5
- Design a simple storm drain and calculate the Hydraulic Grade Line (HGL) using the energy equation and HEC-22
- Describe which energy dissipators are useful for culvert or storm drain applications based on HEC-14

TARGET AUDIENCE:

Entry-level engineers or engineering technicians who are performing highway drainage calculations on transportation facilities. It will also be useful as a refresher course on hydraulic fundamentals for experienced personnel.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

Technical Information: Jorge Pagan • (202) 366-4604 • jorge.pagan@fhwa.dot.gov



Need course registration information? See page 6 in the front of the catalog.

COURSE NUMBER: FHWA-NHI-135067

COURSE TITLE: Practical Highway Hydrology

The course provides engineers and designers with the background and skills necessary for the practical application of hydrologic principles to highway design. Participants will be required to work example problems that stress actual design situations. The course is based on the Hydraulic Design Series (HDS) No. 2, "Highway Hydrology" which is also used in the course as a reference manual.

Participants will learn how to select and effectively implement techniques for estimating peak flows and flood hydrographs in gaged and ungaged streams for watersheds of the size typically encountered in highway drainage design. Through a series of optional modules, additional topics including channel routing, wetland hydrology, arid lands hydrology, and snowmelt hydrology are available given host agency preferences.

The overall course objectives enhance the understanding of basic hydrologic concepts and principles as they pertain to highways, and enable application of appropriate hydrologic concepts and tools in the design of drainage facilities and hydraulic structures.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Identify which peak flow design methods are suitable for given watershed characteristics and design requirements
- Estimate times of concentration
- Apply the SCS, regression and rational methods for peak flows
- Analyze gage flows using Log-Pearson III Frequency Analysis
- Develop hydrographs using the unit hydrograph and other techniques
- Perform storage routing calculations
- Design a storm water management facility

TARGET AUDIENCE:

Highway engineers and designers who are responsible for designing channels, storm drains, and stormwater detention, as well as those involved in the hydraulic design of bridges and culverts. Attendees will benefit from, but are not required to have, a basic knowledge of hydrologic science. The course is a useful primer for those new to the subject and a thorough review for experienced hydrologic and hydraulic engineers.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 30

NHI Training Program Manager: Larry Jones • (703) 235-0523 • larry.jones@fhwa.dot.gov

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COURSE NUMBER: FHWA-NHI-135071

COURSE TITLE: Surface Water Modeling System with Flo2DH and SMS

The host is responsible for providing 15 computers with the following minimum configuration: 850 MHz Intel Pentium III Processor or equivalent with 128 MB RAM, Windows NT 4.0 with Service Pack 6a or 98 Second Edition or 95 (SR-1), 100 MB available disk space, CD-ROM drive, and 1024 x 768 color video display.

The course presentation provides a balance of hydraulic theory, background of the finite element method, data requirements necessary to operate the Flo2DH module of the Finite Element Surface Water Modeling System (FESWMS) computer program and to use of Surface-Water Modeling System (SMS) in the development of input data files and the analysis of the data output.

The Flo2DH is a depth averaged two-dimensional surface water model for analyzing complex flow patterns in river or tidal situations. The program has been designed for modeling bridges and hydraulic structures commonly found in highway hydraulic applications. The program is capable of modeling bridges, bridges in pressure flow, culverts, weir flow over the roadway, and general and local scour through the reach being analyzed. The model is capable of handling steady and unsteady flow through hydraulic systems. Because of the intensive input data requirements and large amounts of output generated by the Flo2DH computer program, the pre- and post-processing program SMS is used in the course. SMS is capable of interactively building finite element networks, including the input data files necessary to use the Flo2DH computer program. The program is also capable of graphically presenting the output from Flo2DH, using a variety of formats.

Participants will receive a notebook that includes course materials, a Flo2DH user's manual and SMS user's manual, including copies of the software used in the course. Non-State highway agency course participants will receive a demonstration version of the proprietary SMS computer program.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Apply the fundamentals and use the capabilities of the Flo2DH computer program to develop two-dimensional water surface elevations and velocity fields
- Develop input data necessary for use in the Flo2DH computer program
- Use SMS as a pre- and post-processing program for the Flo2DH computer program
- Use SMS to build finite element networks and input data files for use with the Flo2DH computer program, including to graphically view and manipulate the output

TARGET AUDIENCE:

Federal, State, and local hydraulic engineers who have responsibility for the design and analysis of highway stream crossings. In order to derive the most benefit from this training, course participants should have knowledge of the fundamentals of open channel flow and should be familiar with the general concepts associated with two-dimensional surface water flow modeling. Experience with Windows-based computer programs is helpful.

FEE: \$650 Per Participant

LENGTH: 5.0 Days (CEU: 3.0 Units)

CLASS SIZE: Minimum: 20; Maximum: 26

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COURSE NUMBER: FHWA-NHI-135080**COURSE TITLE:** Hydrologic Analysis and Modeling with WMS

This course is designed as a hands-on, application-oriented training course using the Watershed Modeling System (WMS) to make hydrologic estimates using a variety of techniques. It will provide attendees with the knowledge and tools necessary to use data derived from geographical information systems (GIS) to develop hydrologic estimates and model runoff from watersheds. The course also teaches how to use digital terrain data for the development of watershed parameters that are required by most commonly used hydrologic analysis programs.

The WMS is a comprehensive environment for hydrologic analysis. It is developed by the Environmental Modeling Research Laboratory (EMRL) of Brigham Young University, and has been licensed for use by all State and Federal highway agencies. WMS makes it possible to take advantage of the wealth of digital terrain, land use, soil, and other GIS data readily available from government and private agencies. This data can then be used for preparing input files for several commonly used hydrologic models. Models supported by the interface include HEC-1 (HMS), TR-20, TR-55, and the Rational Method. This course also includes instruction in use of the regional regression equations contained in the National Flood Frequency (NFF) database. This course teaches the techniques and methods necessary to locate and use GIS data so that labor intensive processes such as delineating watershed boundaries and calculating modeling parameters from paper maps can be avoided when computing design flows and developing flow hydrographs at bridges and culverts.

Participants will receive a notebook that includes course materials, a WMS User's Manual, and copies of the software, workshops, and tutorials used in the course. Non-State highway agency course participants will receive a demonstration version of the proprietary WMS computer program.

OUTCOMES:

Upon completion of the course, participants will be able to:

- Automate basin delineation in WMS with GIS vector data, DEMs, and TINs
- Efficiently use digital watershed data for hydrologic modeling parameter development
- Locate and obtain digital data sources for watershed delineation and hydrologic model development
- Use WMS to build hydrologic input data files for use with HEC-1 (HMS), TR-20, TR-55, regional regression equations, and Rational Method programs, including instruction on how to graphically view the output

TARGET AUDIENCE:

Federal, State, and local hydrologic/hydraulic engineers who have responsibility for the design and analysis of highway stream crossings. In order to derive the most benefit from this training, course participants should have knowledge of the fundamentals of hydrology and hydrologic modeling. Experience with one of the aforementioned hydrologic modeling computer programs would be helpful.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 20; Maximum: 25

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COURSE NUMBER: FHWA-NHI-135081**COURSE TITLE:** Introduction to Highway Hydraulics Software

This course requires computers with the following minimum configuration: 1.6 GHz Intel Pentium III Processor or equivalent with 512 MB RAM, 100 MB available disk space, CD-ROM drive, and Windows XP. One computer is required for every two participants.

The course provides engineers and designers with hands-on computer experience in the selection and application of software tools commonly applied for highway hydraulics including estimating peak flows and hydrographs, as well as the analysis and design of storm drains, culverts, detention basins, and channels. The Watershed Modeling System (WMS) will be the Windows interface used for most applications. Software covered in the course includes:

1. NFF (National Flood Frequency Program)
2. SCS TR-55
3. HEC-1/HEC-HMS
4. FHWA Storm Drain for design of pipes and inlets
5. HY8 for culvert and energy dissipator analysis and design
6. WMS detention basin and channel calculators for detention basin and channel design

OUTCOMES:

Upon completion of the course, participants will be able to:

- Define a drainage outlet and delineate a watershed using WMS
- Compute peak flows using NFF and TR-55
- Perform normal depth and stability calculations using the WMS channel calculator
- Design a culvert using HY8 and the HY8 input generator
- Select and size an energy dissipator using the HY8 energy dissipator software
- Design and analyze storm drain inlets and pipes using WMS and the FHWA storm drain program
- Route a hydrograph through a detention basin using the WMS detention basin calculator

TARGET AUDIENCE:

Highway engineers and designers responsible for the hydrologic and hydraulic aspects of designing storm drains, culverts, detention basins, and channels. Attendees should have a basic knowledge of hydrology and hydraulics. The course will briefly review theory, but will focus on hands-on problem solving.

FEE: \$400 Per Participant

LENGTH: 3.0 Days (CEU: 1.8 Units)

CLASS SIZE: Minimum: 14; Maximum: 20

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